ROUNDSS®

RAM RBlue light reflection function absolute encoder user manual

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Safety matters:

Be careful of grease scattering.

This product employs a reflective optical system integrating LEDs and photosensitive components, making it robust and reliable against axial force and thermal fluctuations of the motor. However, if grease or other oils adhere to the rotating disk, it may prevent the disk surface from reflecting light properly, causing a decrease in signal amplitude and resulting in position detection errors. To prevent oil from adhering to the rotating disk surface, please consider the following countermeasures.

The bearing on the motor side (reverse load side) of the encoder should have a labyrinth structure to prevent internal grease from scattering. (See diagram below)

1. Bearings

（1） Confirmation of Bearing Grease Selection

Please select a grease that prevents grease scattering.

※Example) Koyo Seiko MULTEMP SRL ⇒ KNG144 The evaporation rate and oil separation rate of the grease can affect grease scattering; therefore, please confirm the specifications.

(2) Confirmation of grease filling amount

(3) Bearing seal

Open-type (ZZ type) grease seals are relatively poor; therefore, contact-type rubber-sealed bearings should be used on the reverse load side.

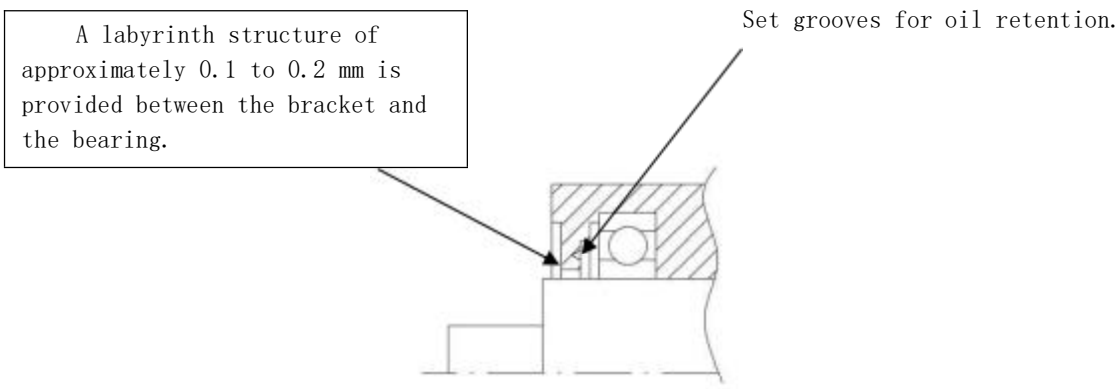
(DDU type for NSK systems; LLU type for NTN systems, etc.)

However, this may increase the no-load torque of the motor and affect bearing life; therefore, it is necessary to conduct a prior study on the motor side.

③ Aging Treatment

In addition to the above countermeasures, the following aging treatment can further improve reliability by causing excess grease to dissipate in the initial stage. Please investigate this further.

・Pre-run the bearing by repeatedly rotating it in both directions and stopping it for an extended period while it is in an Assy state.



Precautions for handling the code disk

If the code track surface gets stained with lubricant or other oil, please wipe it off with a cloth dampened with alcohol. However, please be careful not to use too much force or a cloth made of a hard material, as this may leave marks on the code track surface.

General precautions

• These specifications may be changed without notice due to product improvements and technological upgrades. Please inquire about the latest specifications and confirm the intended use before actual use.

・Please note that this product is intended for use as an embedded component in general electronic devices (OA devices, communication devices, home appliances, entertainment devices, measuring devices, general industrial devices, etc.). It is not intended for applications requiring extremely high reliability and safety (transportation equipment, aerospace equipment, nuclear power control systems, medical devices for life support purposes, etc.).

・Our company is committed to improving quality and reliability; however, malfunctions and failures in semiconductor products are generally unavoidable. Therefore, when using this product, please consider the potential impact of malfunctions and take safety precautions to prevent accidents. Our company is not liable for any damage to life or property caused by malfunctions, failures, or inadequacies related to this product, or for any malfunctions in equipment, facilities, or machinery caused by the installation and use of this product, regardless of the extent of the damage.

Users are responsible for the safety design of their systems.

Product inspection:

All products undergo complete functional testing before leaving the factory. To prevent product malfunctions due to negligence during transportation, please carefully check the following items after unpacking:

- Check that the encoder is the same as the ordered model;
- Inspect the encoder for any damage or scratches. If any damage is found, do not connect the wires or supply power.
- Check the encoder for any loose components or loose screws;

1. Overview:

1.1 Product Introduction:

This manual primarily describes how to use the RAMR Blue Reflective Safety Absolute Series encoders.

These encoders mainly serve servo drive control systems, providing the system with the accurate feedback and auxiliary information required by the position and speed control units.

The encoder's performance has a decisive impact on important characteristics of the motor, such as:

- Positioning accuracy
- speed stability
- Bandwidth determines the response speed and anti-interference performance to drive command signals.
- Motor size

1.2 Technical Parameters:

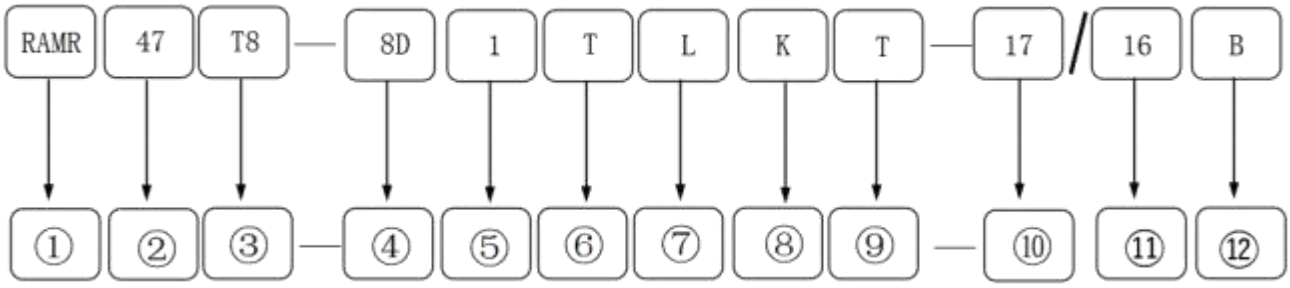
Communication frequency: ≤ 16K;

Baud rate: 2.5MHz;

Cable length: ≤30m; (For cable lengths exceeding 30m, please contact us separately for further discussion)

Spindle speed: ≤6000rpm;

2. Model naming:

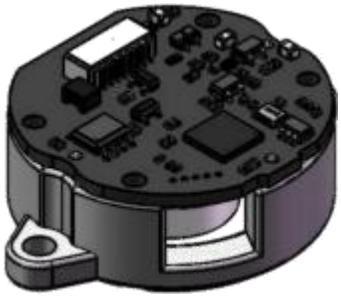


serial number	Definition description
①	Basic Model: Magnetoelectric Blue Light Reflective Absolute Encoder
②	External dimensions: Φ 47mm or Φ 35mm
③	T-axis diameter 8
④	8P terminal output
⑤	5V
⑥	RS485 communication interface
⑦	2.5MHz baud rate
⑧	16K update rate
⑨	Communication protocol periodic transmission
⑩	17-bit single-round resolution (23-bit single-round resolution optional)
⑪	16-bit multi-turn resolution
⑫	Positive logic binary code

Note: If you require a custom wiring harness, please provide the wiring harness specification sheet.

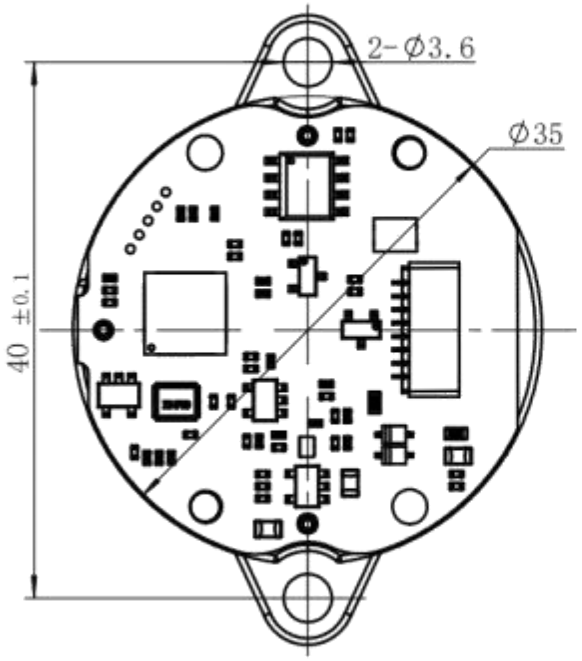
3. Encoder classification:

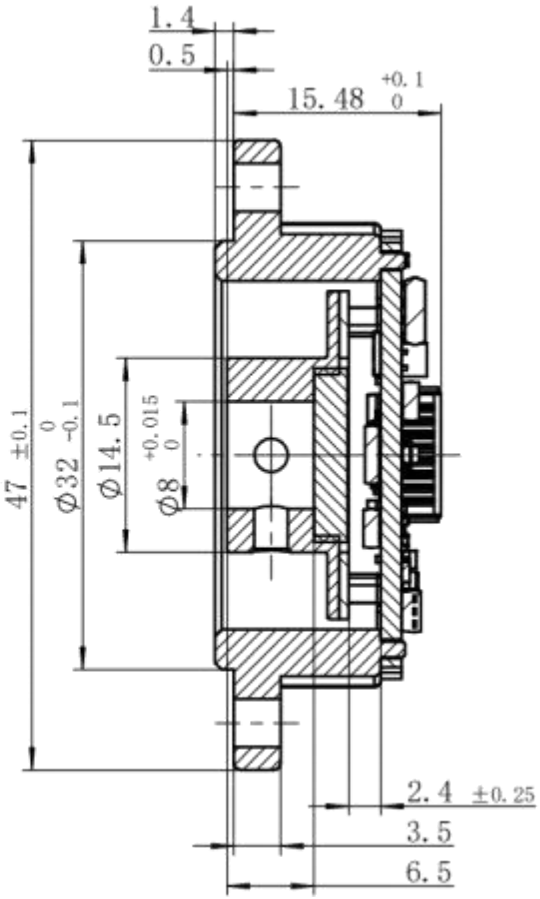
3.1RAMR47T Blue Light Reflective Functional Safety Absolute Series Encoder Size Specifications:



3.1.1 RAMR47T Series with External Stop Bracket Dimensions:

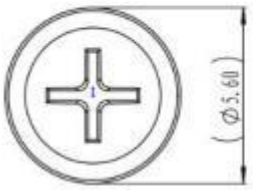
1、 Circuit board and bracket assembly appearance diagram

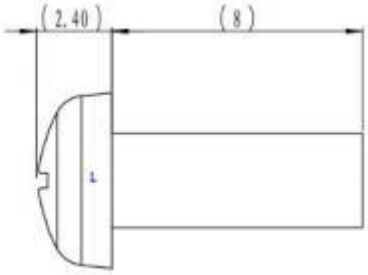




Recommended screws for installation:

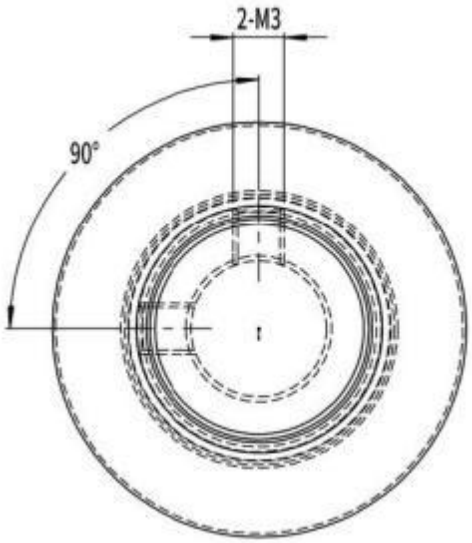
Name	Abbreviation	Standard	Grade	Quantity
Phillips head pan screws	M3×8	GB/T 818-2016	A2-70	2

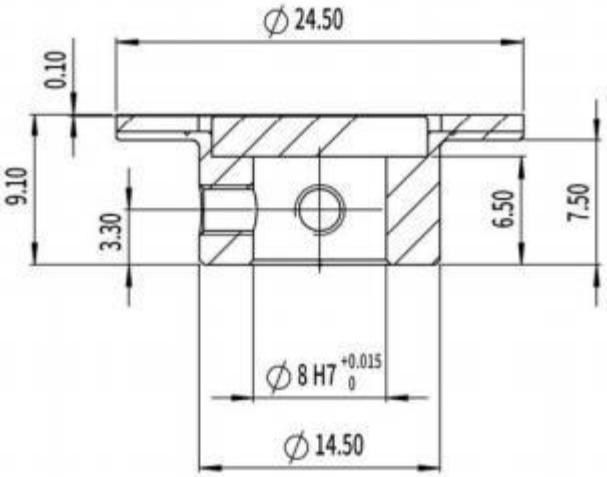




※Screws are not accessories

2、 Image of the encoder assembly (actual product may vary):



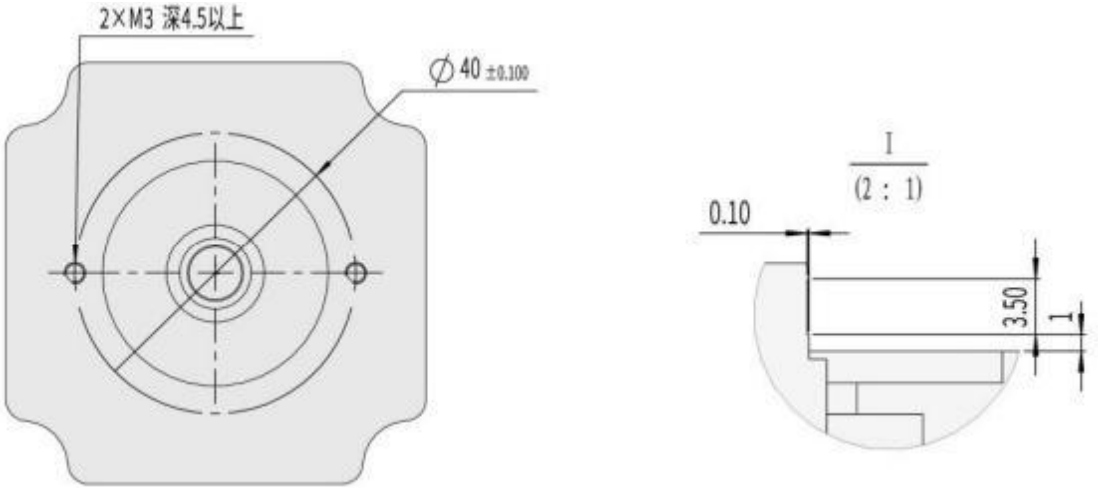


Recommended mounting screws for installation:

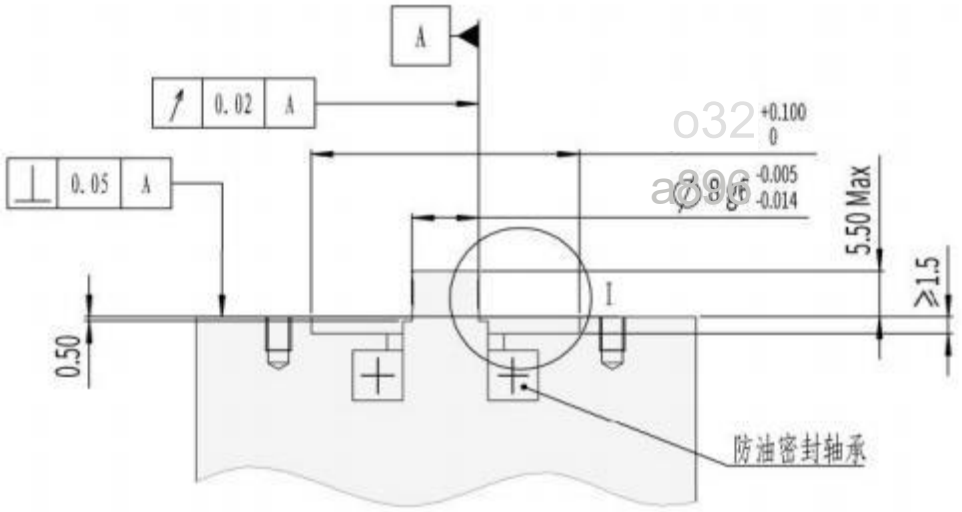
Name	Abbreviation	Abbreviation	Grade	Quantity
Hex socket set screw	M3×3	GB/T 80-2000	>5.8	2

※Screws are not accessories

3.1.2 Recommended installation dimensions diagram (subject to actual processing requirements):

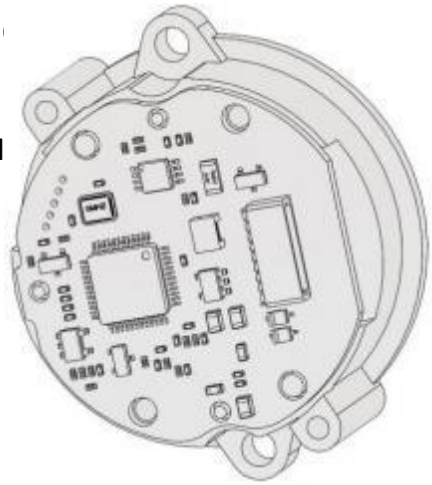


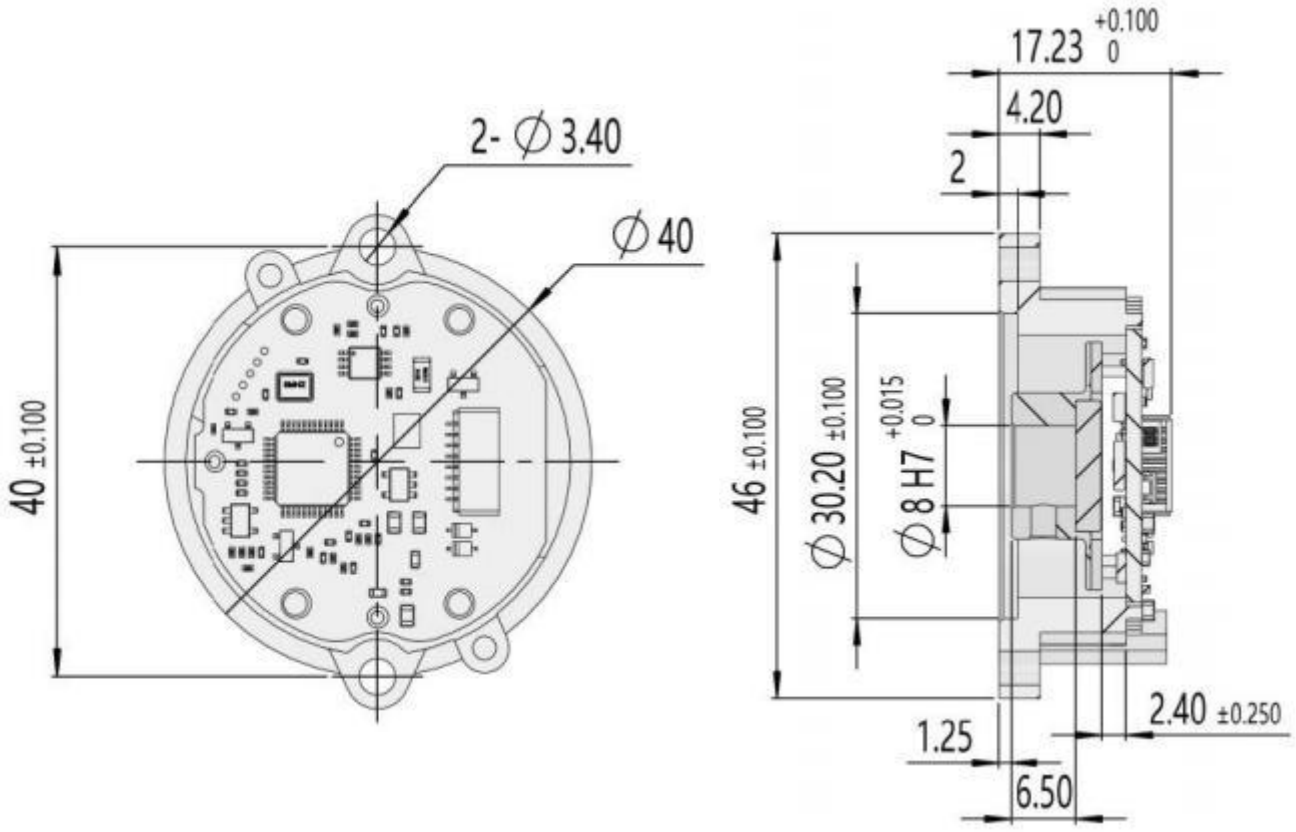
Note 1) Motor runout is within ±0.15mm.



3.2 RAMR47.1T Series of matching inner st specifications:

3.2.1 Visual representation of the circuit board (actual product may vary).:

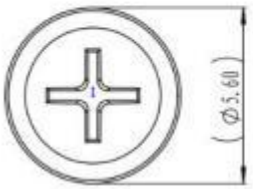


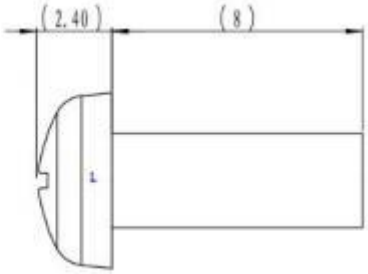


※ The distance between the top surface of the code disk and the PCBA is 2.4mm ± 0.25mm.

Recommended screws for installation:

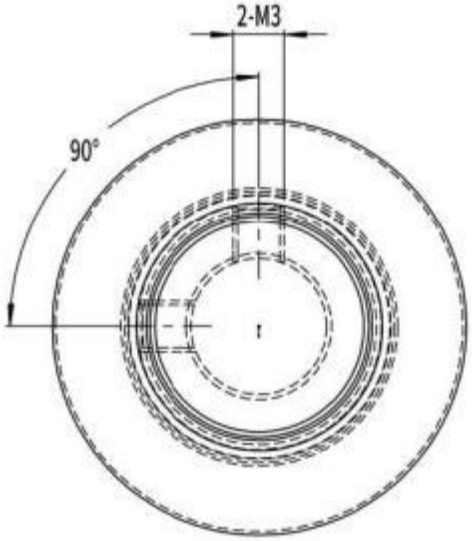
Name	Abbreviation	Standard	Grade	Quantity
Phillips head pan screws	M3×8	GB/T 818-2016	A2-70	2

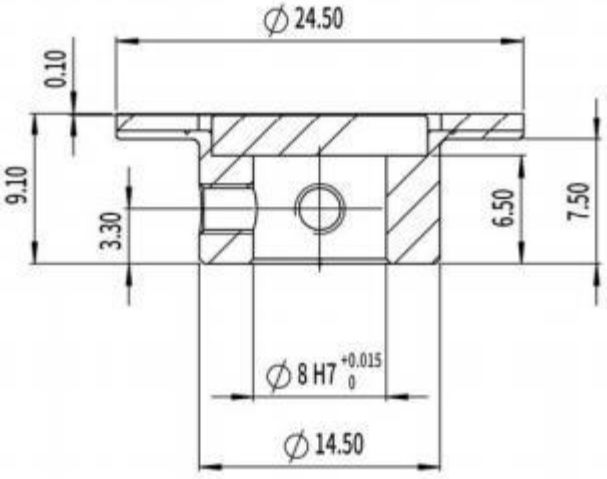




※Screws are not accessories

1、 Image of the encoder assembly (actual product may vary.



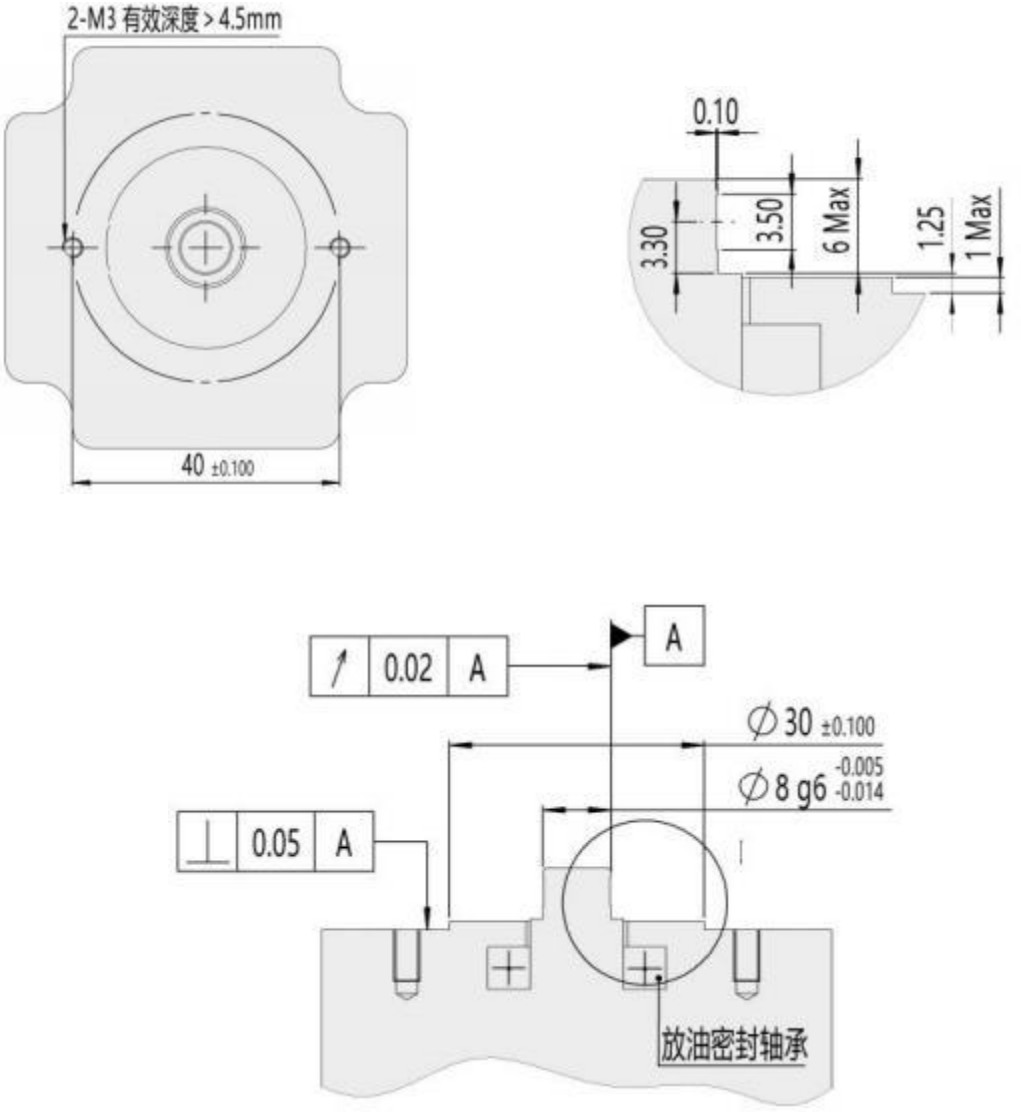


Recommended mounting screws for installation:

Name	Abbreviation	Standard	Grade	Quantity
Hex socket set screw	M3×3	GB/T 80-2000	>5.8	2

※Screws are not accessories

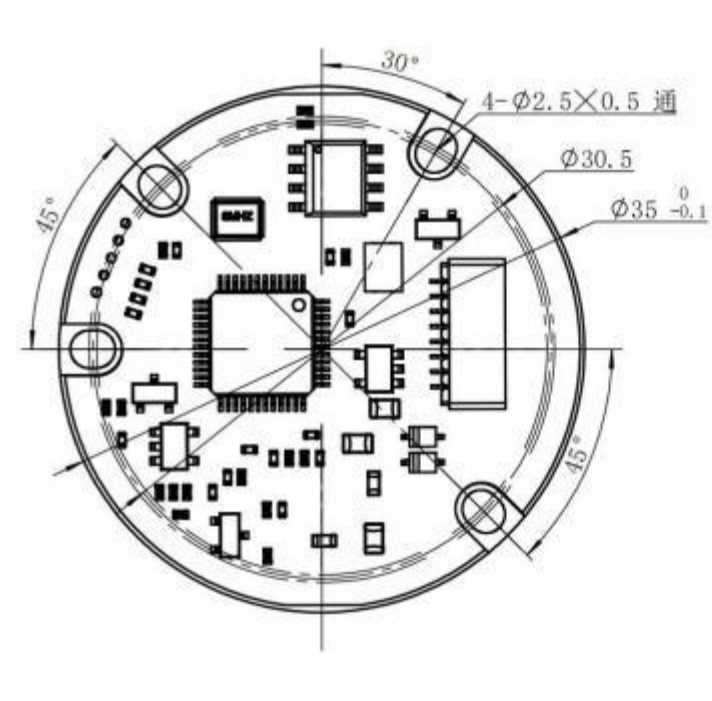
3.2.2 Recommended installation dimensions diagram (subject to actual processing requirements):

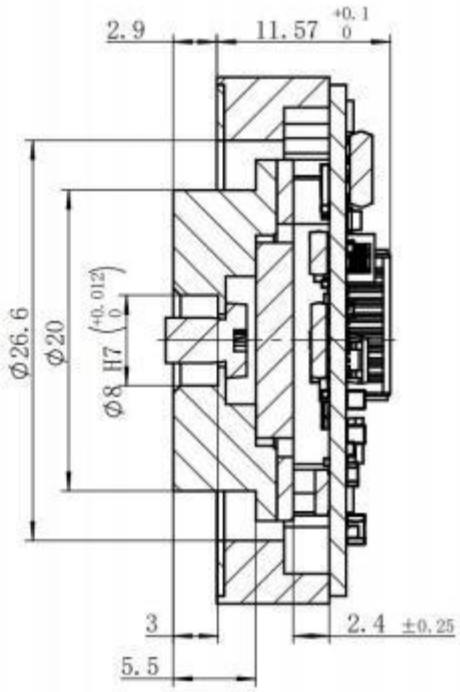


Note 1) The vertical runout of the motor shaft is within ±0.15mm.

3.3 RAMR35.2T8 Series of matching inner stop bracke specifications:

3.3.1 Visual representation of the circuit board and br (actual product may vary).:

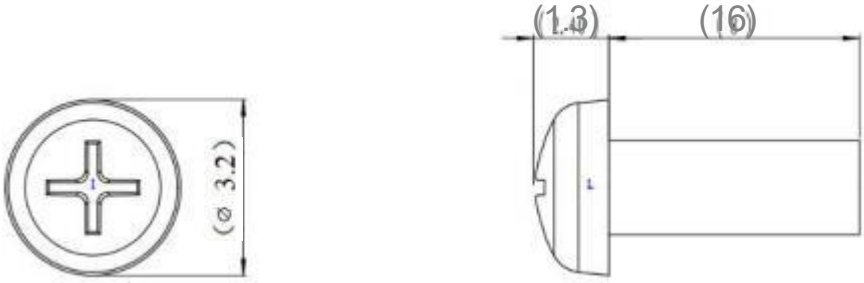




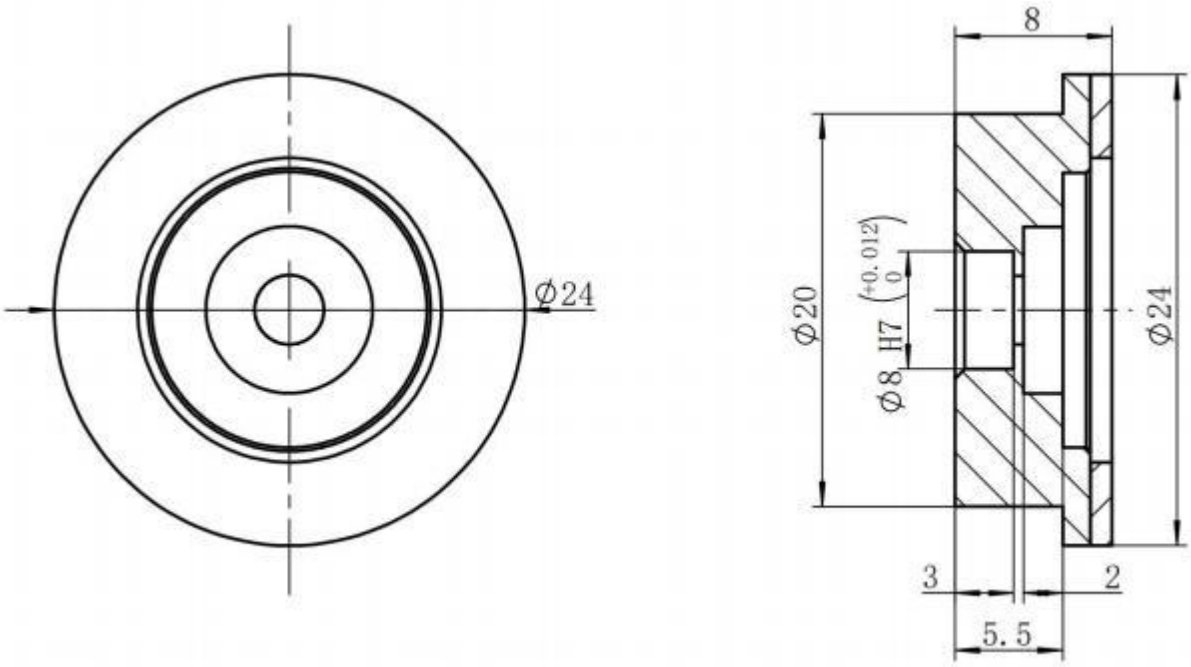
※ The distance between the top surface of the code disk and the PCBA is 2.4mm ± 0.25mm.

3.3.2 Recommended screws for installation:

Name	Abbreviation	Standard	Grade	Quantity
Phillips head pan screws	M2×16	GB/T 818-2016	A2-70	4



1 Image of the encoder assembly (actual product may vary):

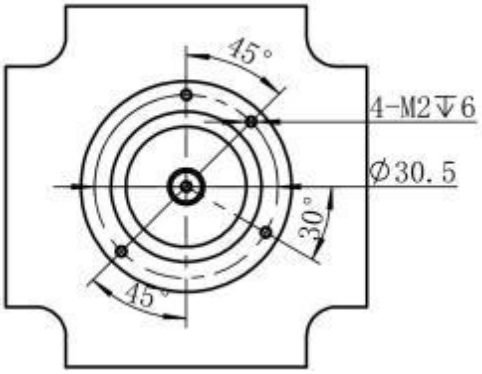


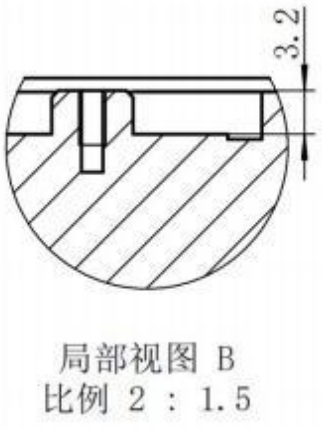
Recommended mounting screws for installation:

Name	Abbreviation	Standard	Grade	Quantity
Phillips head pan screws	M2×6	GB/T 818-2016	A2-70	1

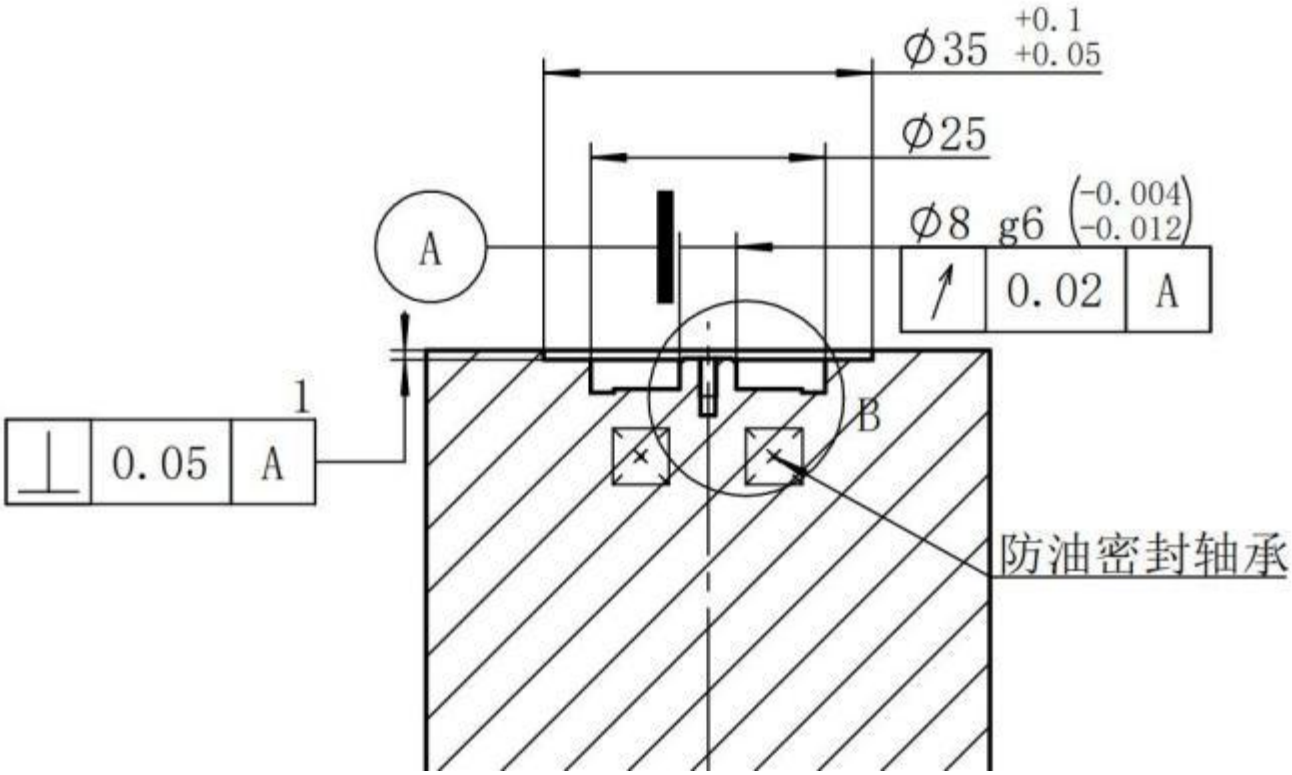
※Screws are not accessories

3.3.3 Recommended installation dimensions diagram (subject to actual processing requirements):





Note 2) Motor runout is within ±0.15mm.



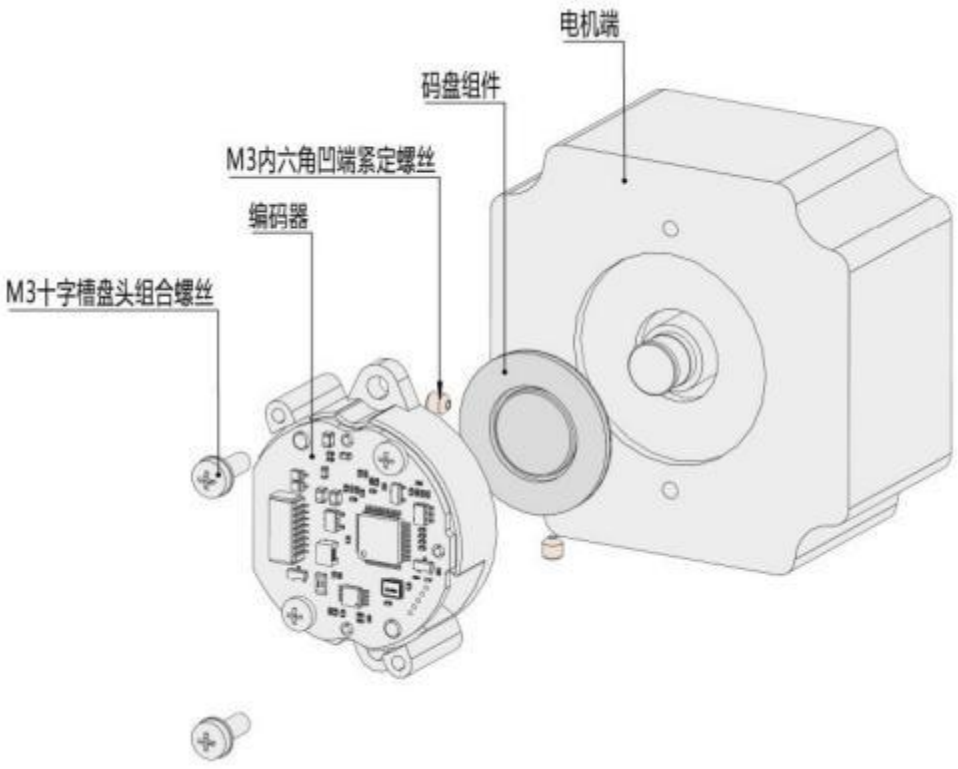
3.4 RAMR47T and RAMR47.1T Install:

3.4.1 Environmental requirements:

Operating ambient temperature: -10℃~90℃.
Operating ambient humidity: Below 90%RH (non-condensing).
Storage ambient temperature: -20℃~100℃.
Storage ambient humidity: Below 95%RH (non-condensing).
Shock resistance: Impact acceleration 980m/s², 11ms; 3 impacts per direction, total 18 impacts.
Vibration resistance: Between 10 and 55Hz, maintaining an amplitude of 1.5mm; Between 55 and 2000Hz, cceleration of 98m/s²; 2 hours per XYZ axis, total 6 hours.

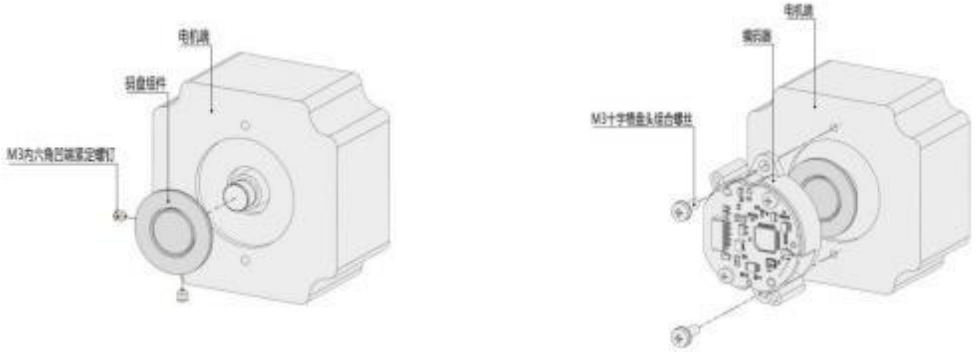
3.4.2 Installation method:

3.4.2.1 RAMR Installation instructions:



Installation diagram

3.4.2.2 Installation steps：



1) Check the code disk assembly for scratches and ensure that all components of the encoder are in normal working order.；

2) Wipe the surface of the code disk with anhydrous alcohol cotton balls to remove dust.；

3) Use M3 Allen screws to install the code disk assembly onto the motor shaft. During installation, be careful not to touch the code disk with your tools to avoid damage. Do not tighten the set screws directly; this allows for easy adjustment of the gap between the code disk and the PCBA when installing the encoder.；

4) Adjust the relative position of the circuit board and the code disk assembly using the debugging fixture, tighten the M3 hex socket set screws to secure the code disk assembly, and secure the encoder with M3 disc head combination screws.；

5) Insert encoder harness。

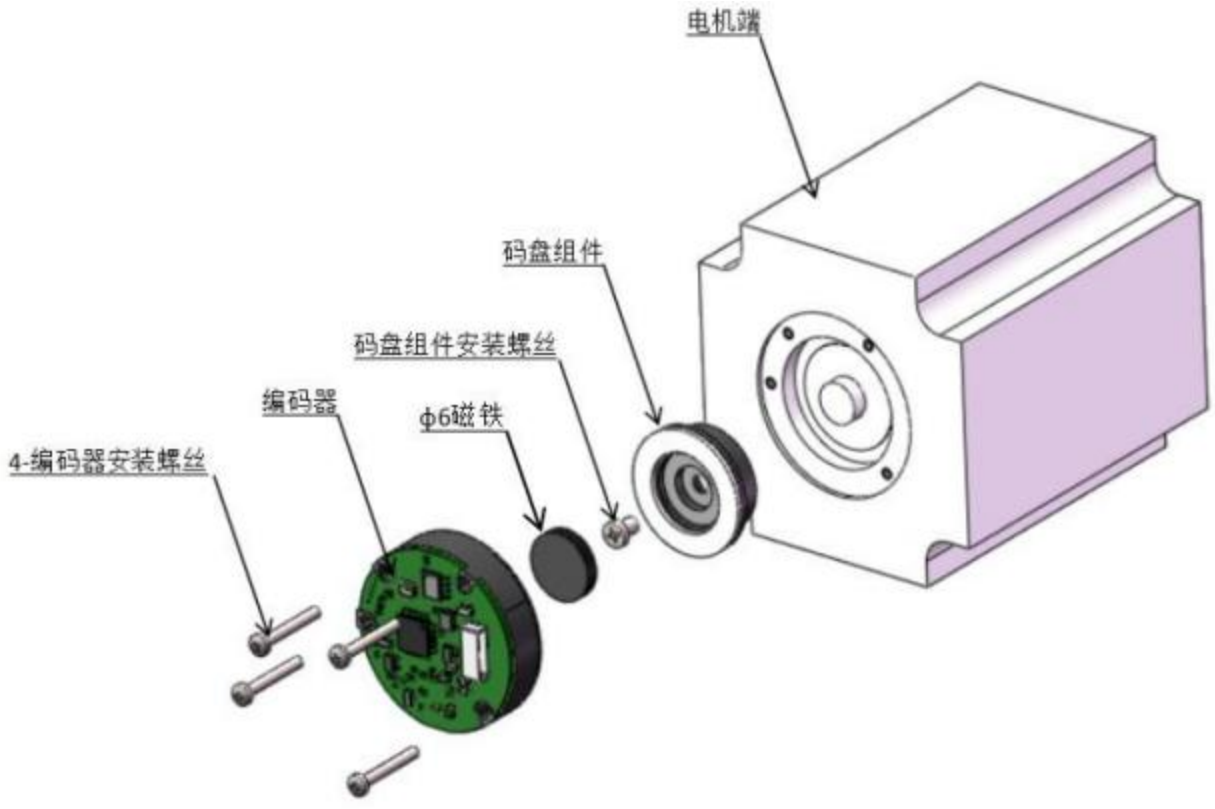
3.5 RAMR35.2T8 Install:

3.5.1 Environmental requirements:

Operating ambient temperature: -10℃~90℃.
Operating ambient humidity: Below 90%RH (non-condensing).
Storage ambient temperature: -20℃~100℃.
Storage ambient humidity: Below 95%RH (non-condensing).
Shock resistance: Impact acceleration 980m/s², 11ms; 3 impacts per direction, total 18 impacts.
Vibration resistance: Between 10 and 55Hz, maintaining an amplitude of 1.5mm; Between 55 and 2000Hz, a cceleration of 98m/s²; 2 hours per XYZ axis, total 6 hours.

3.5.2 Installation method:

3.5.2.1 RAMR Installation instructions:



安装示意图

3.5.2.2 Installation steps:

1) Check the code disk assembly for scratches and ensure all encoder components are functioning properly.;

2) Wipe the surface of the code disk with anhydrous alcohol cotton balls to remove dust.;

3) Use M2 Phillips head screws to install the code disk assembly onto the motor shaft. During installation, be careful not to touch the code disk with your tools to avoid damage. Then, use anaerobic adhesive (648) to attach the magnet to the center of the code disk assembly.;

4) The encoder's relative position is controlled by its outer diameter and the motor's inner stop; the encoder is secured using M2 Phillips head screws.;

5) Insert encoder harness。

4. RAMR Installation precautions:

*Please strictly follow the installation instructions during installation.

*After installation, please do not subject this product to external impact or vibration to avoid changing its installation position.

*Please take special care when installing the code disk. Due to the material, the code disk may break if accidentally bumped or struck by external force. Please also keep the surface of the code disk clean.

*During installation, strictly ensure the machining dimensions and precision of the rear cover and shaft to guarantee the required distance between the code disk and the photosensitive device.

*Please strictly follow the instructions for using the stepped shaft installation method, and use the shaft mating surface shown in the encoder assembly's appearance diagram as the bearing surface. Otherwise, data jitter and other problems may occur. Therefore, please strictly follow the instructions for installation.

*Please strictly follow the instructions to select the correct screws to ensure optimal encoder installation.

5. wiring:

5.1 Cable definition:

1、 NRZ Protocol cable definition:

Cable colors:	Definitions:	Wiring Configuration
Red	5V	Twisted Pair
Black	GND	
Blue	485+	Twisted Pair
Yellow	485-	
Brown	Battery Positive	
White	Battery Negative	
Black heat shrink tubing	PE	

2、 BISS Protocol cable definition:

Cable colors:	Definitions:	Cable Configuration
Red	5V	Twisted Pair
Black	GND	
Blue	MA+	Twisted Pair
Yellow	MA-	
Brown	Battery Positive	Twisted Pair
White	Battery Negative	
Gray	SLO+	
Green	SLO-	
Black heat shrink tubing	PE	

6. Electrical characteristics:

6.1 Electrical parameters:

Specifications (Ambient Temperature T=25℃)	Minimum value	Typical value	Maximum value
Supply Voltage	4.75	5V	5.25
Main Power Supply Current Consumption (Typical)	--	110mA	--
Battery Voltage		3.6V DC	
Battery Supply Current Consumption (No Rotation)			
Battery Supply Current Consumption (6000rpm Rotation)			
Battery Fault Voltage	2.5V	2.75V	3.0V
Battery Warning Voltage	3.0V	3.1V	3.2V
Differential Output Level (High Level)	3.5V	--	--
Differential Output Level (Low Level)	--	--	1.7V
Time of Change	--	--	100ns
Insulation Resistance	50MΩ	--	--

Note: Even with a battery present, the encoder may operate as if there is no battery when the battery voltage is below 2.5V~3.0V, and a battery error BE may occur.

7. Communication protocol:

7.1 Overview:

Unit	Description	Notes
Communication Code System	Binary	--
Communication Circuit	Differential Drive	RS485
Data Transmission Content Communication Rate Unit	Single-Loop Position Information	17bits（最大 23bit）
	Multi-Loop Position Information	16bits
	Status Flags	(1)Counting Error (2)Counter overflow (3)Multi-turn error (4)Battery alarm (5)Battery error
Communication Code System	2.5Mbps	--

*The protocols involved in the encoder are all customized by the client. It is normal for some clients to experience incomplete compatibility. If there is a need for protocol customization or matching, we can discuss and develop it together.

7.2 EEPROM Communication specifications:

Unit	Address	Describe
Readable/Writable User Parameter Address Range	0~0x7E	This address field can be used to store user parameters.
Also Address	0x7F	0-2
Maximum Erasable/Write Cycles	100000 Second-rate	The number of times the user parameter save and write operation can be executed.。

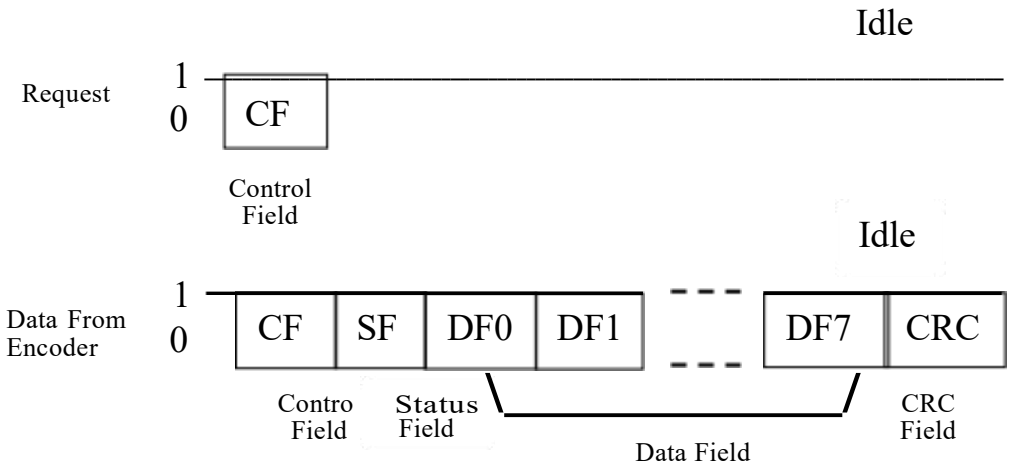
7.3 frame format:

Each data frame consists of several bytes. The transmission and reception of each byte are achieved by 1 start bit, 8 data bits, and 1 stop bit, with the least significant bit first and the most significant bit last.

The terminology used in data frame transmission is shown in the table below:

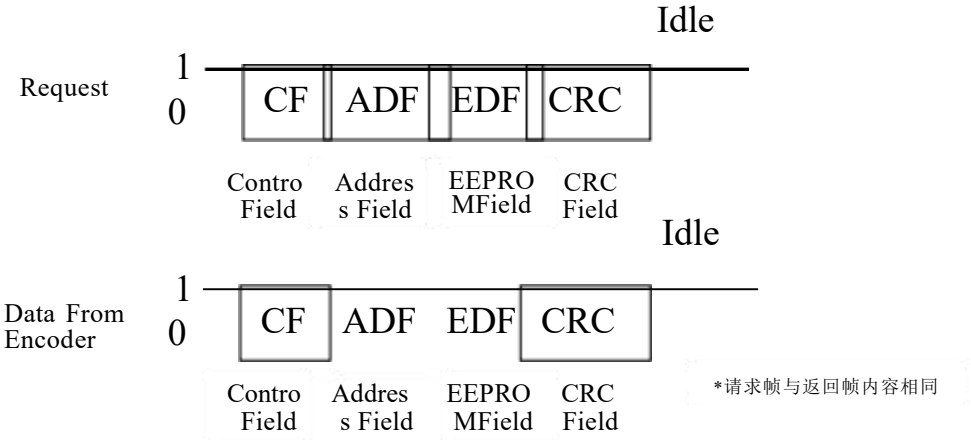
Unit	Describe	Remark
CF	Control Field	This is used to identify different command types.
SF	Status Field	This section provides information about the encoder status.
DF	Data Field	Encoder position data
ADF	Address Field	Accessible encoder address
EDF	E2PROM Field	The content of the address
CRC	CRC 校验	Polynomial: x8+1 (XOR all data except CRC)

7.3.1 Location data reading:

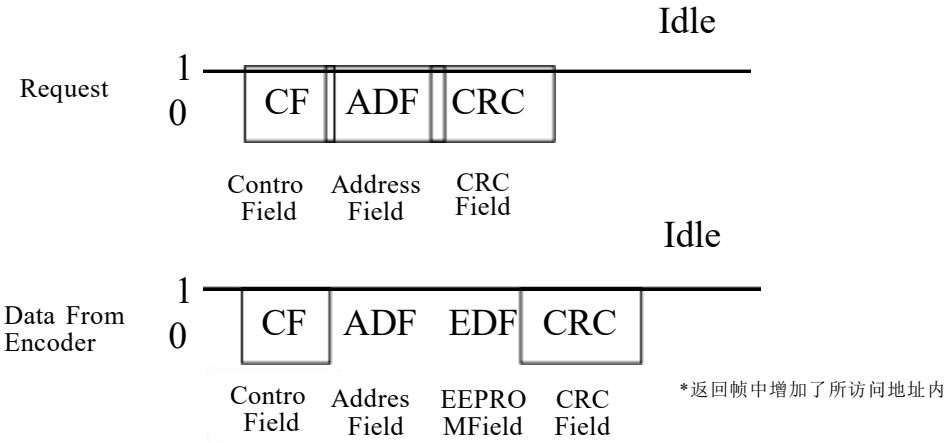


Note: The number of data in a DF depends on the specific CF.

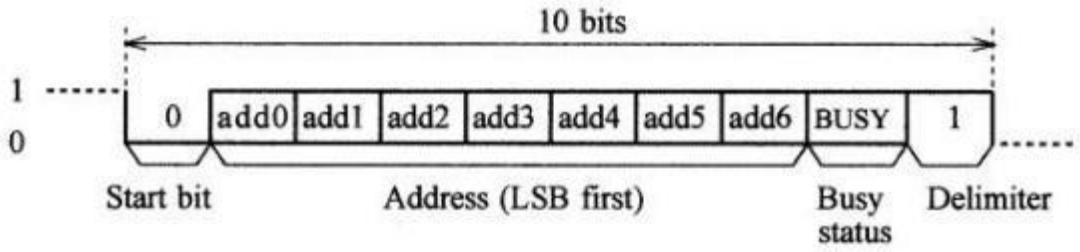
7.3.2 write EEPROM:



7.3.3 read EEPROM:



7.3.4 operate EEPROM timely ADF and EDF:



(1) Start bit:fixed。

(2) Address:eeprom Address range 0~127。

(3) Busy status: The access status to EEPROM can be checked by checking the busy status bit.。

	Ask	Encoder sends data			
	Busy	Busy	ADF	EDF	Describe
EEPROM Read	0	0	ADF	Eeprom	Normal read
		1	ADF	0x00	Encoder busy, read request invalid
EEPROM Write	0	0	ADF	EDF	Request accepted
		1	ADF	0x00	Encoder busy, write request invalid

7.4 Elaborate:

7.4.1 Control Field（CF）:

A CF consists of 1 byte, and its categories and contents are shown in the table below.:

CF	CF content	Remark
Read Data	ID0（0x02）	Absolute position information reading
	ID1（0x8A）	Multi-lap data information reading
	ID2（0x92）	Read 17-bit encoder ID information (0x11) Read 23-bit encoder ID information (0x17)
	ID3（0x1A）	Read all data (single revolution + multiple revolutions + fault flag + encoder ID)
Write EEPROM	ID6（0x32）	The 8-bit "user data" can be written to the corresponding data at the specified address. The encoder will send back data within 20μs after the command format is completed; please do not communicate with the encoder during this process.。
Read EEPROM	IDD（0xEA）	The 8-bit "user data" can be read from the specified address. The encoder will send back data within 20μs after the command format is completed; do not communicate with the encoder during this process.
Reset	ID7（0xBA）	The reset command requires sending 10 commands consecutively at intervals of not less than 62.5μs to reset all fault flag bits.
	ID8（0xC2）	The reset command requires sending 10 commands consecutively at intervals of not less than 62.5μs to reset any single-turn position to zero. Even after power is restored, the position data will remain as reset.
	IDC（0x62）	The reset command requires sending 10 commands consecutively at intervals of no less than 62.5μs to reset multi-turn data to zero (without affecting single-turn data). Simultaneously, all fault flag bits are reset.

7.4.2 Status Field（SF）:

SF consists of 1 byte, and the definition of each bit is shown in the table below:

Unit	Describe	Remark
Bit0	Rsvd	All are "0"
Bit1	Rsvd	
Bit2	Rsvd	
Bit3	Rsvd	
Bit4	Counting Error	If the encoder position calculation fails, this bit will be set to 1.
Bit5	Output multi-turn error, battery error, and battery alarm.	View sub-faults via ALMC
Bit6	Rsvd	0
Bit7	Rsvd	0

7.4.3 Data Field（DF0~DF7）:

Depending on the CF type, the DF has different numbers of bytes, as shown in the table below:

注:

CF type	DF0	DF1	DF2	DF3	DF4	DF5	DF6	DF7
ID0（0x02）	ABS0	ABS1	ABS2					
ID1（0x8A）	ABM0	ABM1	ABM2					
ID2（0x92）	ENID							
ID3（0x1A）	ABS0	ABS1	ABS2	ENID	ABM0	ABM1	ABM2	ALMC
ID7（0xBA）	ABS0	ABS1	ABS2					
ID8（0xC2）	ABS0	ABS1	ABS2					
IDC（0x62）	ABS0	ABS1	ABS2					

1、ABS0 to ABS2 represent the low, middle, and high bits of the encoder's absolute position, respectively. For a 17-bit encoder, the highest 7 bits of ABS2 are 0, and the remaining data form the 17-bit position information. For a 23-bit encoder, the highest bit of ABS2 is 0, and the remaining data form the 23-bit position information.;

2、ABM0~ABM2 represent the low, middle, and high bits of the encoder's multi-turn position, with ABM2 being all 0s. The other data constitute 16 bits of multi-turn information.;

3、 ENID is the encoder's ID, with a 17-bit value of 0x11 and a 23-bit value of 0x17.;

4、 ALMC is the encoder fault flag bit; see section 5.4.4 for details.;

7.4.4 Fault description:

ALMC The faults are shown in the table below.:

Bit	0	1	2	3	4	5	6	7
Fault name	“0”	“0”	Counting error	Counter overflow	“0”	Multi-turn error	Battery error	Battery alarm

The descriptions of each fault flag are shown in the table below:

Fault name	Function description	Solutions
Counting error	Single-cycle information calculation failure	Power cycle
Multi-turn error	Multiple laps data loss, multiple laps counting failure	Fault reset
Counter overflow	When the multi-turn counter overflows, a logic "1" will be displayed.	Fault reset
Battery error	Battery voltage below 2.75V, set to [position].	Check the battery power supply line and replace the battery.
Battery alarm	Battery voltage below 3.1V, set to [position].	The problem disappeared automatically after replacing the battery with one of the correct voltage.

8. Errata:

Serial number	Page number	Parts	Error	Right	Illustrate